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CHANGE RECORD

ISSUE	DATE	PAGES	DESCRIPTION	RESPONSIBLE
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CHANGE RECORD

ISSUE	DATE	PAGES	DESCRIPTION	RESPONSIBLE
			P/N in Figure 3-5 updated Connector in Table 3-2 updated (from MS275005E17F6S to MS3472L14-12S) HRFIS 3.2.2.1.3.1.1.20/H updated with new connector (MS3475L14-12P) specified in Table 3-3, DC/DC P/N updated, cables P/N provided as reference and delivery of connectors MS3472L14-12S included. HRFIS 3.2.2.1.3.1.1.40/M: 3.5 amps replaces 2 amps HRFIS 3.2.2.1.3.1.1.50/M: 4 amps replaces 2.5 amps HRFIS 3.2.2.1.3.1.1.80/M: 3.5 amps replaces 2 amps HRFIS 3.2.2.1.3.1.1.100/M: circuit breaker in figure updated to 3.5 amps HRFIS 3.2.2.2.3.1.1.20/M: exceptions included Figure 3-6, Figure 3-7 updated Table 3-10 updated 3.2.2.3, third sentence: “For information purposes.” added Table 3-10 updated with IP and Subnet Mask addresses HRFIS 3.2.3.2.2.1.1.10/B: req. added HRFIS 3.2.3.2.2.1.1.20/B: MARES IP modification procedure updated 3.2.3.2.4: SCSI HD size modified (from 18 to 36 Gbyte)	

CHANGE RECORD

ISSUE	DATE	PAGES	DESCRIPTION	RESPONSIBLE
			HRFIS 3.2.3.2.4.1.1.10/B: req. added HRFIS 3.2.3.2.4.1.1.20/M: req. reworded HRFIS 3.2.3.2.4.1.1.30/M: MARESSYS in one HD only HRFIS 3.2.3.2.5.1.1.10/B: requirement clarified HRFIS 3.2.3.2.5.1.1.40/B: requirement clarified HRFIS 3.2.3.2.9.1.1.10/M: Introduces SCSI electrical & data i/f requirement. Note added (single-ended mode in MARES) HRFIS 3.2.3.3.1.1.1.70/M: New req. added HRFIS 3.2.3.3.3.2.1.30/M: Last sentence added HRFIS 3.2.3.3.3.3.1.10/M: Last sentence added HRFIS 3.2.3.3.3.3.3.10/M: Last three paragraphs added HRFIS 3.2.3.3.3.3.3.30/M: Last sentence added HRFIS 3.2.3.3.3.3.3.40/M: New req. added APPENDIX: Table 4-1 updated	

TABLE OF CONTENTS

LIST OF ACRONYMS

ADAS	Ambulatory Data Acquisition System
ADP	Acceptance Data Package
BCD	Binary-coded decimal
BMU	Basic Motion Unit
CB	Crew Branch
CCB	Configuration Control Board
CHIP	Common Hardware Implementation Plan
CIL	Critical Items List
COF	Columbus Orbital Facility
COL	Columbus Module
CP	Connector Panel
C.o.G.	Centre of Gravity
COTS	Commercial-of-the-Shelf
CSCI	Computer Software Configuration Items
CR	Change Request
DCN	Drawing Change Notices
DR	Discrepancy Report
E	Electrical (Power) Interface
EEE	Electrical, Electronic, and Electromechanical
EGSE	Electrical Ground Support Equipment
ESA	European Space Agency
EUE	Experiment Unique Equipment
ExD	Ecternal Device(s)
FM	Flight Model
FMS	Flight Model Spare
FMEA	Failure Modes and Effects Analysis
FRD	Functional Requirements Document
FTP	File Transfer Protocol
FP	Front Panel
GFS	Government Furnished Software
GIDEP	Government and Industry Data Exchange Program
GSE	Ground Support Equipment
H&S	Health and Status
HD	Hard drive
HRD	Hardware Requirements Document
HRF	Human Research Facioity
HRS	Human Restraint System
IP	Internet Protocol
ISPR	International Standard Payload Rack
ISS	International Space Station
JSC	Johnson Space Center
LSA	Launch Structure Assembly
M	Mechanical Interface

MARES	Muscle Atrophy Research and Exercise System
MB	Main Box
MGSE	Mechanical Ground Support Equipment
MPLM	Mini Pressurized Logistics Module
MFS	Mares File System
MVC	Maximal Voluntary Contraction
NASA	National Aeronautic & Space Administration
NFS	Network File System
NSTS	National Space Transportation System
PC	Portable Computer
PCS	Portable Computer System
PDA	Pre-delivery Acceptance Test
PEMS	Percutaneous Electrical Muscle Stimulator
PIA	Pre-installation Acceptance
PIP	Power Interface Panel
PRD	Program Requirements Document
PSC	Physiological Signal Conditioner
QA	Quality Assurance
QM	Qualification Model
ROM	Range of Motion
S&MA	Safety and Mission Assurance
SCSI	Small Computer System Interface
SDP	Software Development Plan
SIR	Standard Interface Rack
SMACAR	Safety and Mission Assurance Certification Approval Request Form
SMD	Strength Measurement Device
SOEP	Science and Operations Evaluation Plan
STO	Sub-Task Order
SUP	Standard Utility Panel
SW	Command and Data Handling Interface
TBC	To Be Confirmed
TBD	To Be Determined
TCP	Transmission/Transport Control Protocol
TM	Training Model
TPS	Test Preparation Sheet
TRR	Test Readiness Review
UIP	Utility Interface Panel
UOP	Utility Outlet Panel
VDC	Volts, direct current
VIF	Vibration Isolation Frame
WS2	Workstation 2

1. Introduction

1.1 Purpose

The purpose of this Document is to define the MARES interfaces with the Human Research Facility (HRF) MARES Rack and associated elements.

Interface Requirements are identified under the heading **HRFIS x.x.x.x.x.x.x.x/y**, where

- x.x.x.x.x.x.x.x corresponds to the requirement number
- y indicates the requirement's applicability (H for HRF, M for MARES and B for both).

1.2 Scope

The specifications established herein are applicable to MARES and the HRF hardware that interfaces to MARES. This document defines the external interfaces in section three.

1.3 Muscle Atrophy Research and Exercise System (MARES)

MARES is a physiological research facility, part of the HRF, to be used on board ISS. MARES will be used to carry out research on musculoskeletal, biomechanical, neuromuscular and neurological physiology, to study the effect of microgravity on the human being, and to evaluate the effect of the countermeasures to the Space environment induced physiological effects. MARES can also be used to evaluate the performance of exercise tests protocols.

The MARES hardware is aisle-mounted hardware on the HRF MARES rack, capable of assessing the strength of isolated muscle groups, around specific joints or on complete limbs, by measuring and controlling the interrelation between speed and torque/force, as functions of time.

The following sections define the different components of this payload. Some of them are provided by NTE, as MARES responsible and the others are supplied by HRF. The detailed component suppliers' list is shown in Appendix 1.

1.3.1 MARES Main Box (MB)

The MARES Main Box will contain a motor unit assembly, controller, power electronics, supervision electronics, connector panel, battery, set of harnesses devoted to subsystems interconnection and heat rejection systems. In addition, the Static Lever (element of the Human Restraint System) is always attached to the Main Box for mechanical assembly reasons.

1.3.2 Vibration Isolation Frame (VIF)

The purpose of the Vibration Isolation Frame is to avoid the perturbation of the microgravity environment of ISS while MARES is in use. At the same time, it keeps MARES in its correct position, and limits the range of displacement of the equipment. The VIF and MARES Main Box can be easily and quickly separated for stowage.

1.3.3 Human Restraint System (HRS)

The MARES Human Restraint System is composed of several large structures and numerous smaller items. The chair and pantograph are connected together and to the main box to form the core support items for the subject. Many belts, adapters, and pads are utilized to restain the subject. The items are selected for the specific experiment protocol and to fit the subject.

1.3.4 Modified ISPR (HRF MARES Rack)

The HRF MARES Rack is a modified International Standard Payload Rack (ISPR) and will house the MARES components during on-orbit activities. The HRF MARES Rack will also be utilized to launch some MARES components including the Main Box. The Launch Structure Assembly (LSA) will be attached to the HRF MARES Rack for launch.

1.3.5 Launch Structure Assembly (LSA)

The Launch Structure Assembly will provide a mechanical interface to HRF MARES Rack components and MARES components for launch. A modified plate will be utilized to mount the main box and stowage bags containing the launch package items. Some MARES items will be launched in soft stowage.

1.3.6 Power Interface Panel (PIP)

The Power Interface Panel will provide an electrical interface to the MARES equipment. The PIP supplies 120VDC from station resources. These station resources are the Utility Interface Panel (UIP), Standard Utility Panel (SUP), and Utility Outlet Panel (UOP).

1.3.7 HRF Portable Computer (HRF PC)

The HRF Portable Computer, either from Rack 1 or Rack 2, will be utilized to execute MARES graphical user interface software. The PC will be mounted to the MARES chair using standard hardware and seat track. It is powered by MARES, and interfaces to the Main Box through an Ethernet cable.

1.3.8 HRF Workstation 2 (HRF WS2)

Although the HRF Workstation2 does not belong to the MARES payload, this section is included since MARES will interface to HRF WS2 as detailed within this document. The HRF Workstation 2, either from Rack 1A or Rack 2A, will be utilized to transmit real-time data to the Telescience Support Center for engineering and experiment support. It is powered by the appropriate rack, and interfaces to the Main Box through the HRF Ethernet cable.

1.3.9 Integrated HRF MARES Components

The principal components of Integrated HRF MARES shall be:

- Main Box assembly
- Vibration Isolation Frame (VIF)
- Human Restraint System (HRS)
- Modified ISPR, also referred to as HRF MARES Rack

- Launch Structure Assembly (LSA)
- Power Interface Panel (PIP)
- Portable computer for interaction with the crew
- Associated cables to connect the various MARES components together, to the ISS and to HRF

The launch/landing configuration of MARES is shown in Figure 1-1 and Figure 1-2. During launch and landing, the MARES Main Box (including the Motor assembly, the Static lever and the Connector Panel and excluding all the other elements) will be attached to the LSA. The remaining MARES payload elements will be stowed in soft bags.

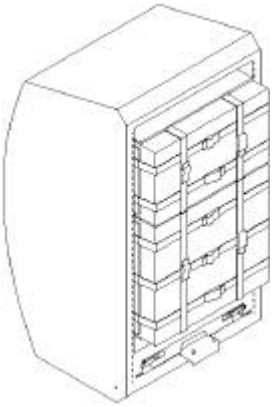


Figure 1-1: HRF MARES Rack in launch/landing configuration

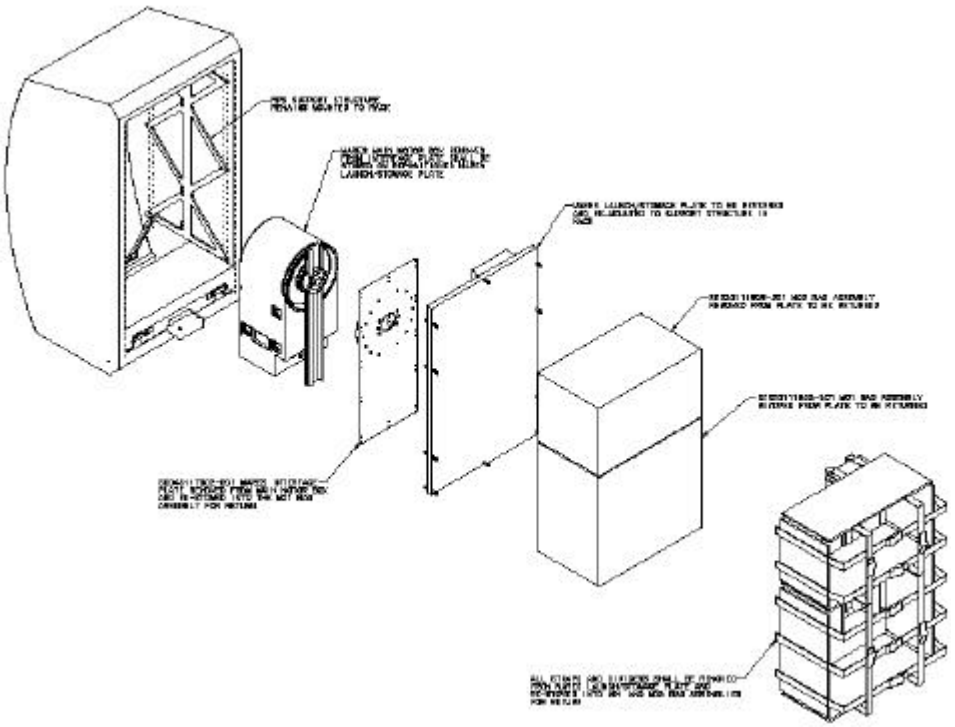


Figure 1-2: Launch/landing configuration details

The MARES facility will be launched in different packages for easy launch accommodation. Once on-orbit, MARES will have to be assembled. During on-orbit operations, MARES will be deployed in the aisle. A concept view of the deployed system is shown in Figure 1-3. When not used on-orbit, MARES will be stowed in the HRF MARES Rack, see Figure 1-4.

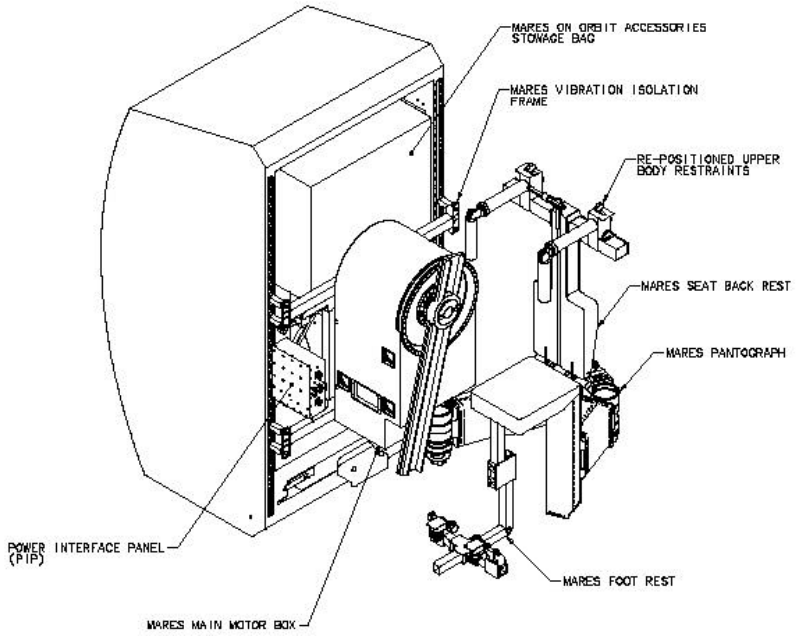


Figure 1-3: MARES System deployed on isle

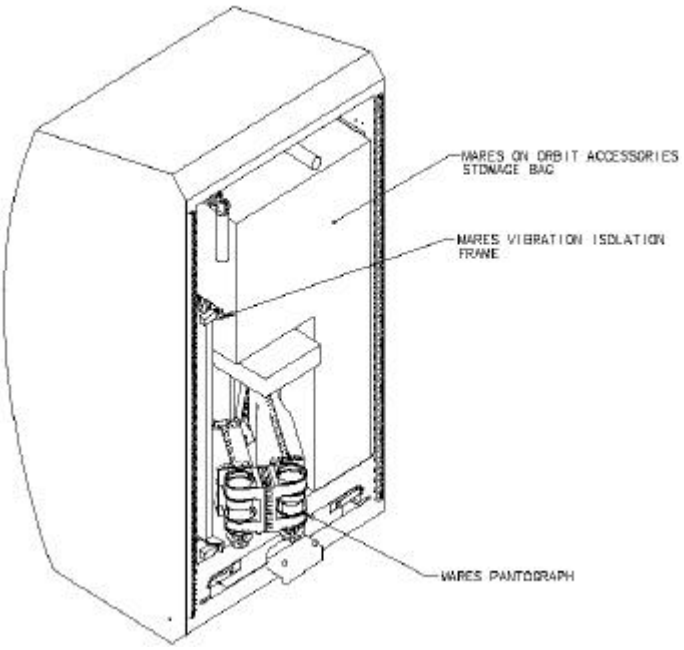


Figure 1-4: MARES System in stowed configuration

2. APPLICABLE AND REFERENCE DOCUMENTS

The following documents are considered applicable to the extent defined in subsequent sections of this document. Reference documents listed in 2.5 are intended to provide the reader with additional information sources, only.

2.1 Specifications

AD1	SSP 57007	Rev A 30 Nov 2001	International Standard Payload Rack (ISPR) Structural Integrator's Handbook
AD2	SSP 41017	Rev H 18 May 2001	Rack to Mini Pressurized Logistics Module (MPLM) Interface Configuration Document (ICD) Part 2

2.2 Standards

N/A

2.3 Publications

AD3	LS-71053-1	Issue 3, Revision 3, 6 Dec 2002	Hardware Requirements Document (HRD) For the Muscle Atrophy Research And Exercise System (MARES) Of The Human Research Facility (HRF)
AD4	LS-71090-1		Hardware Requirements Document (HRD) for the Human Research Facility (HRF) Muscle Atrophy Research and Exercise System (MARES) Rack

2.4 Selection of Specifications and Standards

Specifications and standards necessary for design and development shall be selected in the following order of preference, except as otherwise specified in this document. The exact issue shown is to be used, unless otherwise specified in this document. In case of conflict, the order of precedence shall be:

1. The MARES HRD LS-71053-1

2. The HRF MARES Rack HRD LS-71090-1

3. SSP 57007

2.5 Reference Documents

RD1	LS-71098	April 1997	Common Hardware Implementation Plan (Chip) For the Human Research Facility
RD2	SSP 30242	22 Dec 1998 Revision E	Space Station Cable/Wire Design Requirements for Electromagnetic Compatibility

RD3 LS-71046-1	July 1999	Interface Definition Document for the Portable Computer of the Human Research Facility
RD4 LS-71042-14-4A	March 2002	Interface Definition Document for the HRF Rack 2 Workstation (R2WS)
RD5 MAR-204-ESA/JC	12/11/2003 Issue 3.4	MARES – PEMS II ICD

3. INTERFACES

3.1 Interfaces Definition

The interfaces to MARES are shown in Table 3-1. Mechanical and Power i/f are displayed in Figure 3-1. Detailed descriptions of each interface are provided in the following subsections.

Table 3-1: MARES HRF Interface Definition Matrix

	MARES			
	Mechanical I/F	**Power I/F**	**N/A**	**Comd&DH I/F**
MARES VIF Interface	MARES-VIF-M			
HRF VIF Interface	VIF-HRF-M			
HRF MARES Interface	MARES-HRF-M			
MARES Launch Interface	MARES-LSA-M			
HRF Workstation 2	MARES-HD-M			MARES-WS-SW MARES-HD-SW
HRF Portable Computer	MARES-PC-M	MARES-PC-E		MARES-PC-SW
External Devices		MARES-ExD-E		MARES-ExD-SW
HRF Common Hardware				MARES-Test-SW
HRF Power Interface Panel		MARES-PIP-E		
M: Mechanical interface E: Electrical (Power) interface SW: Command and Data Handling Interface				

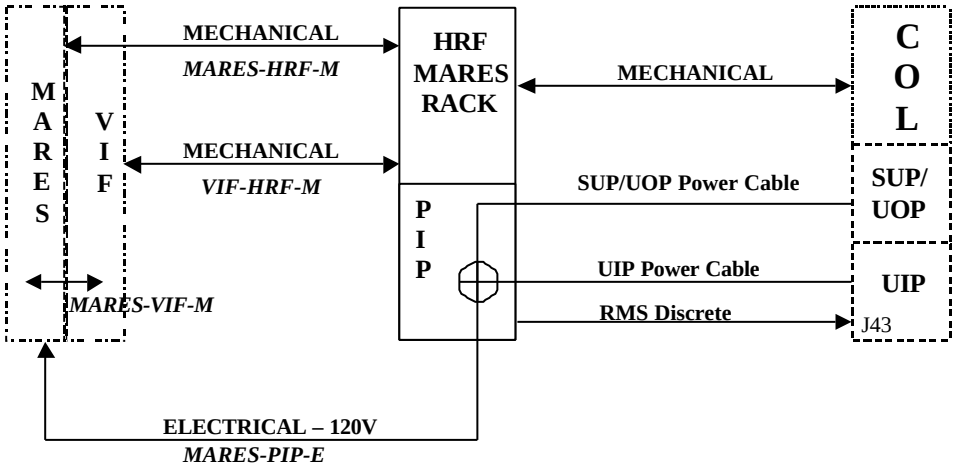


Figure 3-1: MARES Mechanical and Power Interfaces

3.2 Interfaces Requirements

3.2.1 Structural Mechanical Interfaces

3.2.1.1 MARES to HRF Removable Hard Disk Interface (MARES-HD-M)

Through this interface MARES will be able to interchange files with the HRF Workstation 2 by the procedure of carrying the Hard Disk from MARES to the HRF Workstation 2 and vice versa.

HRFIS 3.2.1.1.1.1.10/B

MARES shall be able to accommodate two HRF removable 36 Gbyte SCSI Hard Disks being compatible with the mechanical interface defined in the NASA drawing SEG46117767, rev NC, dated 14/09/01.

3.2.1.2 MARES Connector Panel (CP)

MARES shall have a Connector Panel grouping

- All the external connectors
- 4 LEDs indicating the MARES status
- The MARES ON/OFF pushbuttons
- Two circuit breakers that protect the External Devices and MARES PCS power supply outputs
- Two fuse holders, one with the fuse that protects the MARES interface with the ISS power bus and another carrying a spare fuse

HRFIS 3.2.1.2.1.1.1.10/M

This CP shall be placed in the right (front view) lateral panel of the MARES main box and shall have the distribution shown in *Figure 3-2*[1].

HRFIS 3.2.1.2.1.1.1.20/H

For cables connecting MARES to external devices, cables stiffness shall not affect microgravity performance.

3.2.1.3 MARES Main Box to VIF Mechanical Interface (MARES-VIF-M)

The interface MARES Main Box/VIF is an internal MARES system interface. However, for on-orbit stowage purposes, it shall be possible to mount the Main Box to a structure having the same mechanical interface MARES Main Box/VIF. For this reason this mechanical interface (MARES-VIF-M) is defined.

HRFIS 3.2.1.3.1.1.1.10/M

MARES shall be easily detached from the VIF using the interface defined in drawing MARES-DR-00-000027-NTE, is. 00, dated 22/07/03, see *Figure 3-3*.

[1] The final CP configuarion will feature an ON/OFF switch instead of the ON/OFF buttons shown in *Figure 3-2*

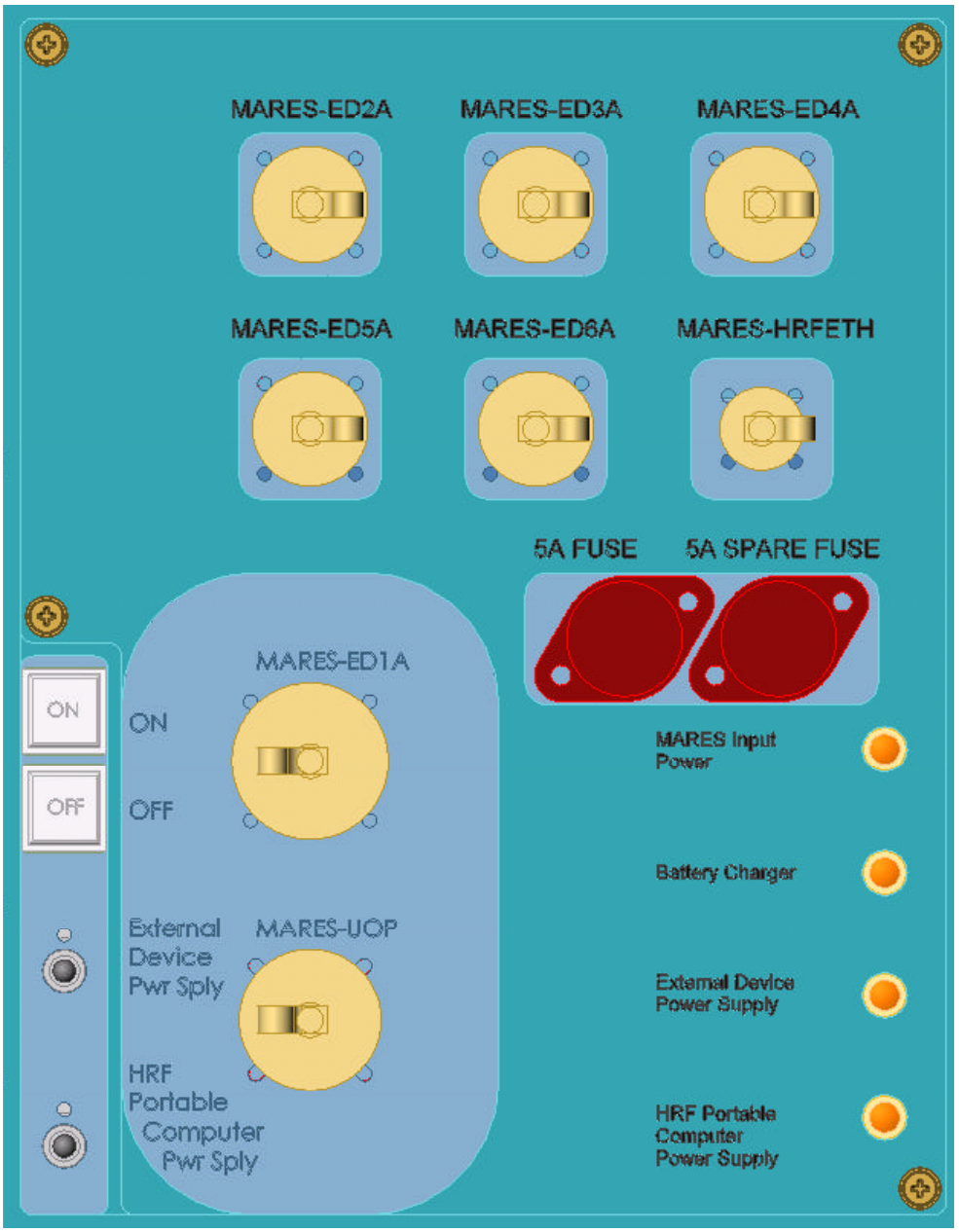


Figure 3-2: Connector Mating Panel (CP) Layout

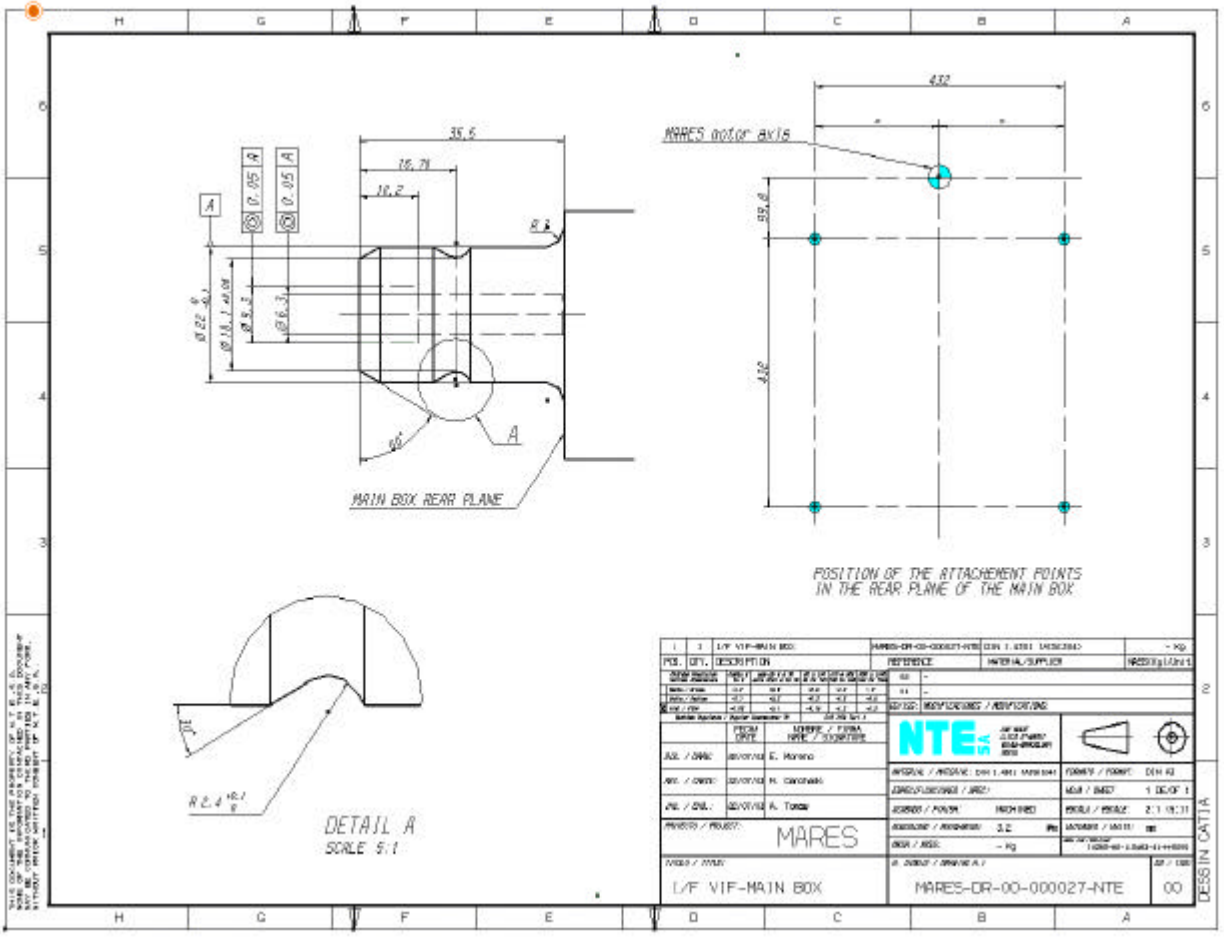


Figure 3-3: MARES Main Box to VIF i/f

3.2.1.4 VIF to HRF Mechanical Interface (VIF-HRF-M)

The VIF shall be attached to the HRF MARES Rack using the seat track interface specified in SSP 57007 (loads) and SSP 41017 (mechanical).

HRFIS 3.2.1.4.1.1.1.10/B

Load requirements applicable to the VIF-HRF-M interface shall be as specified in SSP 57007.

HRFIS 3.2.1.4.1.1.1.20/B

Mechanical dimensions applicable to the VIF-HRF-M interface shall be as specified in SSP 41017.

3.2.1.5 MARES to HRF Mechanical Interface (MARES-HRF-M)

HRFIS 3.2.1.5.1.1.1.10/H

HRF will be able to mechanically interface to the MARES Main Box using the MARES-VIF-M interface. HRF will utilize the accommodation on the Main Box that is used by the VIF quick-disconnect system to facilitate stowage. Details of this interface are provided in section 3.2.1.3.

3.2.1.6 MARES to Launch Interface (MARES-LSA-M)

HRFIS 3.2.1.6.1.1.1.10/B

MARES Main Box shall be able to be attached, for launch, to the HRF Launch Structure Assembly (LSA) defined in JSC drawing SDG46117502, rev C, dated 17/09/03 with interface defined in MARES drawing MARES-DR-00-000026-NTE, is.00, dated 20/06/03 (see Figure 3-4). The remaining components of MARES shall be stowed for launch.

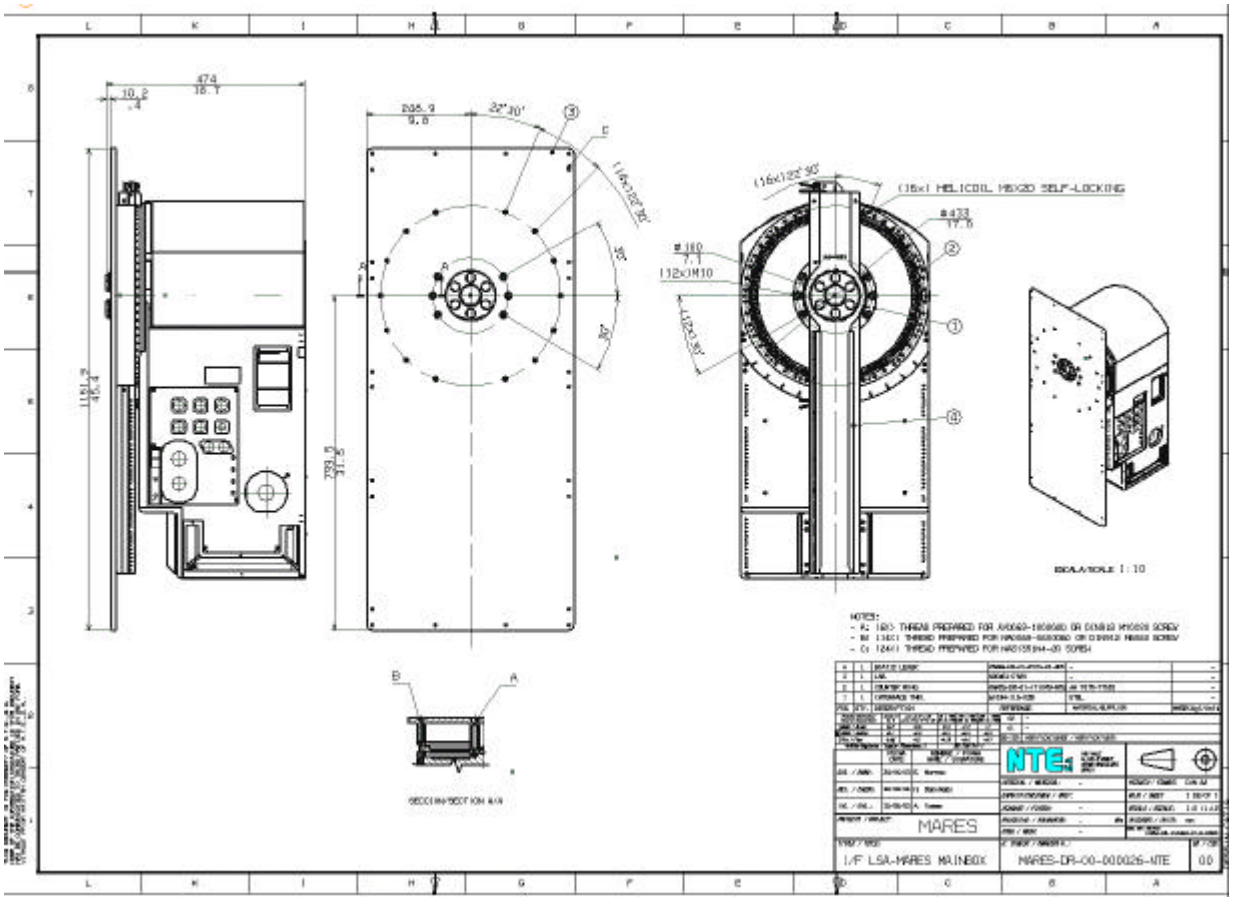


Figure 3-4. MARES Main Box to HRF LSA Interface Attach Points

HRFIS 3.2.1.6.1.1.1.20/B

M10 and M6 fasteners to be used for attaching the MARES Main Box and LSA shall be as per the following specifications:

MODEL	M10x80	M6x60	Provider
Flight (FM/FMS)	AV0069-100080	NA0069-060060	HRF
Quantity per model	6	14	-
Material type in MARES side	AISI 304	AISI 304 (insert)	-

AV0069-100080 is a vendor specific part number. Specifications for this fastener are based on standard NA0069, with a coarse pitch of 1.5 (vs. 1.25 of the standard) and a nylon-locking pellet added per MIL-F-18240.

Note: NTE will provide DIN equivalent fasteners for the qualification tests with MARES QM.

3.2.1.7 MARES to HRF PC Mechanical Interface (MARES-PC-M)

HRFIS 3.2.1.7.1.1.1.10/H

The HRF Portable Computer shall be mounted for use by MARES subjects using a Multi-use Bracket Assembly, P/N SEG33107631-301 and DeskTop Plate Assembly, P/N SED33108703-302 to the MARES chair seat track.

HRF shall provide one set of laptop mounting arm and desktop plate or equivalent for the MARES FM and MARES FMS

NTE shall provide similar elements for the MARES ground models (TM and QM).

3.2.2 Power Interfaces

3.2.2.1 MARES to HRF Portable Computer Electrical Power Interface (MARES-PC-E)

Through this interface the MARES HRF Portable Computer will be powered from the MARES through the MARES-PCPW connector located in the MARES pantograph, as shown in Figure 3-5.

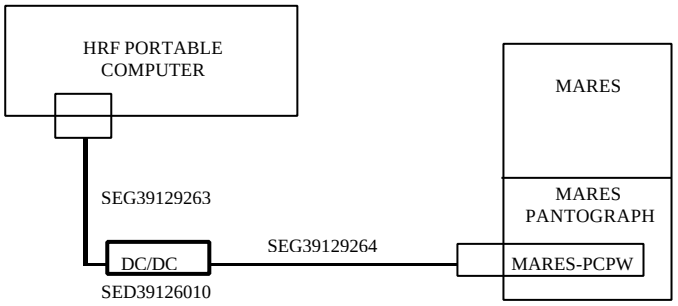


Figure 3-5: MARES to HRF PC Power Interface

HRFIS 3.2.2.1.1.1.1.10/M

MARES shall provide a power connection for the HRF Portable Computer through the connector defined in Table 3-2.

Table 3-2: Portable Computer Power Interface (MARES Side)

Connector name:	**Type:**	**Features:**
MARES-PCPW	MS3472L14-12S	MIL-C-26482 Female connector, 8 pins #20, 4 pins #16 (Series 2)

Connectors pin out					
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
J	Portable Computer +28 V	Power/out	HO	Voltage: 28±1 V Current: up to 3.5 Amps Load reg (Pout 10% to 100%) ±500mV	Portable Computer power supply
K	Portable Computer +28 V return	Power/out	HO		
L	Chassis Ground				
A-H, M	Not connected				

HRFIS 3.2.2.1.1.1.1.20/H

HRF shall interface with the connector defined in HRFIS 3.2.2.1.1.1.1.10/M through the connector specified in Table 3-3:

Table 3-3: Portable Computer Power Interface (HRF Side)

Connector name:	**Type:**	**Features:**
DC POWER 28VDC CABLE ASSY P2 TO ORBITER 28VDC POWER RECEPTACLE	MS3475L14-12P	MIL-C26482 Male connector, 8 pins #20, 4 pins #16 (Series 2)

Connectors pin out					
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
J	Portable Computer +28 V	Power/out	HO	Voltage: 28±1 V Current: up to 3.5 Amps Load reg (Pout 10% to 100%) ±500mV	Portable Computer power supply
K	Portable Computer +28 V return	Power/out	HO		
L	Chassis Ground				
A-H, M	Not connected				

In addition HRF shall provide the following elements, as shown in Figure 3-5:

- Portable Computer,
- DC/DC converter (P/N SED39126010)
- Power cables (P/N SEG39129263 and SEG39129264 indicated in Figure 3-5 are provided as reference, only)

- Connector MS3472L14-12S (MARES-PCPW) for all models

HRFIS 3.2.2.1.1.1.30/M

MARES shall provide 28 ± 1 volts through this interface under any load condition defined below.

HRFIS 3.2.2.1.1.1.40/M

MARES shall be able to provide a continuous current of up to 3.5 amps.

HRFIS 3.2.2.1.1.1.50/M

MARES shall be able to provide a peak current of 4 amps until the circuit breaker will trip.

HRFIS 3.2.2.1.1.1.60/M

MARES output power supply shall provide a load regulation of ± 500 mV for a load change from 10% to 100%.

HRFIS 3.2.2.1.1.1.70/M

MARES output power supply shall provide a ripple lower than 100 mV.

HRFIS 3.2.2.1.1.1.80/M

MARES shall provide an over-current protection using a circuit breaker. This circuit breaker will be 4 amps rated and will meet the requirements of the MIL-C-39019C, time delay A.

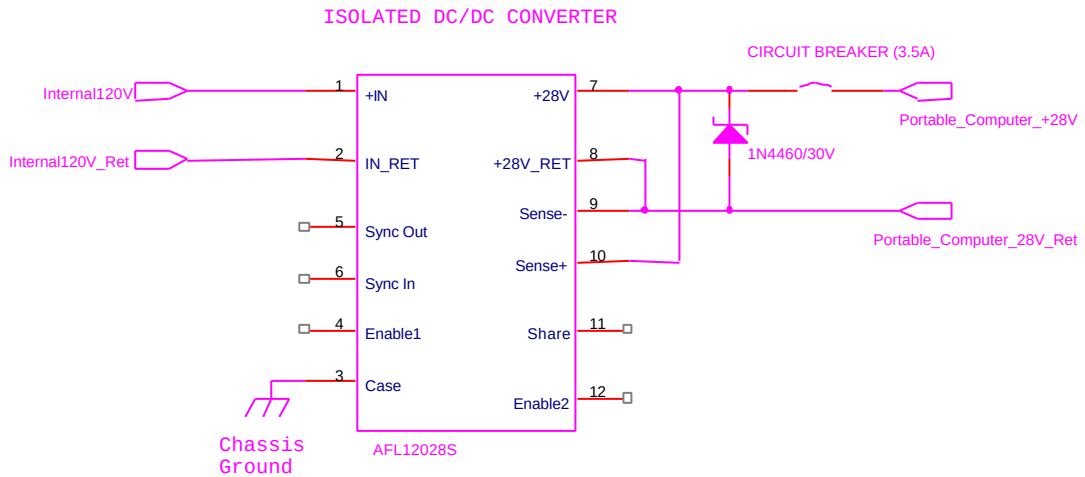
HRFIS 3.2.2.1.1.1.90/M

This power outlet shall be protected against reverse currents of up to:

- 5 Amps, in pulses of up to 1 ms
- 2.5 Amps, in pulses of up to 10 ms
- 0.15 Amps, in steady-state

HRFIS 3.2.2.1.1.1.100/M

The equivalent circuit of the power supply output shall be:



3.2.2.2 MARES to External Devices Electrical Power Interface (MARES-ExD-E)

MARES shall provide power for external instrumentation like physiological conditioners and Percutaneous Electrical Muscle Stimulator II (PEMS II).

HRFIS 3.2.2.2.1.1.1.10/M

MARES shall provide power to external devices through the connector MARES-ED1A in the MARES Main Box Connector Panel, defined in Table 3-4.

Table 3-4: External Device Power Interface

Connector name:	**Type:**	**Features:**
MARES-ED1A	MS27505E17F6S	MIL-C-38999 Female connector, 6 pins #12 (Series I)

Connectors pin out					
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
A	ExtDev+28 V	Power/out	HO	Voltage: 28±1 Current: up to 2 Amps Load reg (Pout 10% to 100%) ±500mV	External device power supply
B	ExtDev+28 V return	Power/out	HO		
C	Chassis Ground				
D-F	Not connected				

HRFIS 3.2.2.2.1.1.1.20/M

MARES External Device Power supply shall be in accordance with the requirements in HRFIS 3.2.2.1.1.1.30 to HRFIS 3.2.2.1.1.1.100 with the following exceptions:

- Continuous current shall be 2A
- Peak current shall be 2.5A
- Circuit breaker breaker shall be 2A rated

3.2.2.3 MARES to HRF Power Interface Panel Interface (MARES-PIP-E)

Through this interface the HRF Power Interface Panel (PIP) shall provide 120VDC to MARES.

Cables designed to interface between the HRF PIP and MARES will utilize mating connectors to the interface described in Table 3-5 and Table 3-6. The source of power for the PIP shall be from an ISPR location Utility Interface Panel (UIP), Utility Outlet Panel (UOP), or Standard Utility Panel (SUP).

For information purposes, HRF has existing equipment that can interface MARES to the PIP: HRF Common Power Cable 120VDC, JSC drawing SEG46115684.

HRFIS 3.2.2.3.1.1.1.10/M

MARES input power connector, located in the Main Box Connector Panel shall be as shown in Table 3-5.

Table 3-5: MARES Input Power Interface

Connector name:	**Type:**	**Features:**
MARES I/P	D38999/20FD97PN	MIL-C-38999 Series III, 8 #20 & 4 #16 pins

Connectors pin out					
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
M	ISS 120V	Power/in	EO	Voltage: 120 VDC ± 6 Current: up to 10 Amps	Input power
L	ISS 120V ret	Power/in			
G	Chassis Ground				
A-C, D-F, H, J-K	Not connected				

HRFIS 3.2.2.3.1.1.1.20/H

HRF Power Interface Panel (PIP) output power connector shall be as shown in Table 3-6.

Table 3-6: HRF PIP Power Output Interface

Connector name:	**Type:**	**Features:**
J1 Power Out	D38999/20FD97SN	MIL-C-38999 Series III, 8#20 & 4 #16 sockets

Connectors pin out					
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
M	120 VDC Supply	Power/out	EO	Voltage: 120 VDC ± 6 Current: up to 10 Amps	Output power to MARES
L	120 VDC Return	Power/out			
G	Chassis Ground				
A-C, D-F, H, J-K	Not connected				

3.2.3 Command and Data Handling Interfaces

3.2.3.1 MARES to HRF Portable Computer Command and Data Handling Interface (MARES-PC-SW)

Through this interface MARES will establish communication with the HRF Portable Computer over an Ethernet link through the MARES-PCETH connector, located in the MARES pantograph, as shown in *Figure 3-6*.

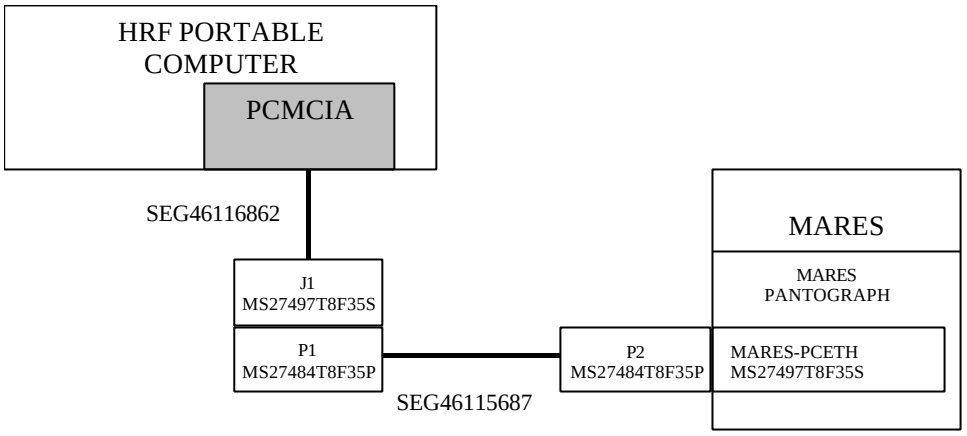


Figure 3-6: MARES to HRF PC Ethernet Interface Diagram

HRFIS 3.2.3.1.1.1.1.10/H

HRF shall provide the following external data cables:

- SEG46115687, Common Ethernet Cable, defined in LS-71098, Common Hardware Implementation Plan for the HRF (CHIP). This cable is 8 feet in length.
- SEG46116862, Common Ethernet Card/Cable, defined in LS-71046-1, Interface Definition Document For The Human Research Facility Portable Computer. This cable is 3 feet in length

HRFIS 3.2.3.1.1.1.1.20/M

MARES shall provide an Ethernet connection for the Portable Computer as defined in Table 3-7.

Table 3-7: Portable Computer Ethernet Interface

Connector name:	**Type:**	**Features:**
MARES-PCETH	MS27497T8F35S	MIL-C-38999 Female connector, 6 pins #22 (Series II)

Connectors pin out					
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	Ethernet TX+	Ethernet	RF	IEEE 802.3 i 10-BASE-T Ethernet/ IEEE 802.3 u 100-BASE-Tx Ethernet. Automatic sensing	Ethernet channel TX
2	Ethernet RX Shield				
3	Ethernet RX+	Ethernet	RF		Ethernet channel RX
4	Ethernet RX-	Ethernet	RF		Ethernet channel RX
5	Ethernet TX-	Ethernet	RF		Ethernet channel TX
6	Ethernet TX Shield				

3.2.3.2 MARES to Human Research Facility Rack Command and Data Handling Interface

3.2.3.2.1 MARES to HRF Workstation 2 Interface (MARES-WS-SW)

This interface is established through the connector MARES-HRFETH located in the MARES Main Box Connector Panel plus a cable to connect MARES to the HRF Workstation 2 connector, as shown in Figure 3-7.

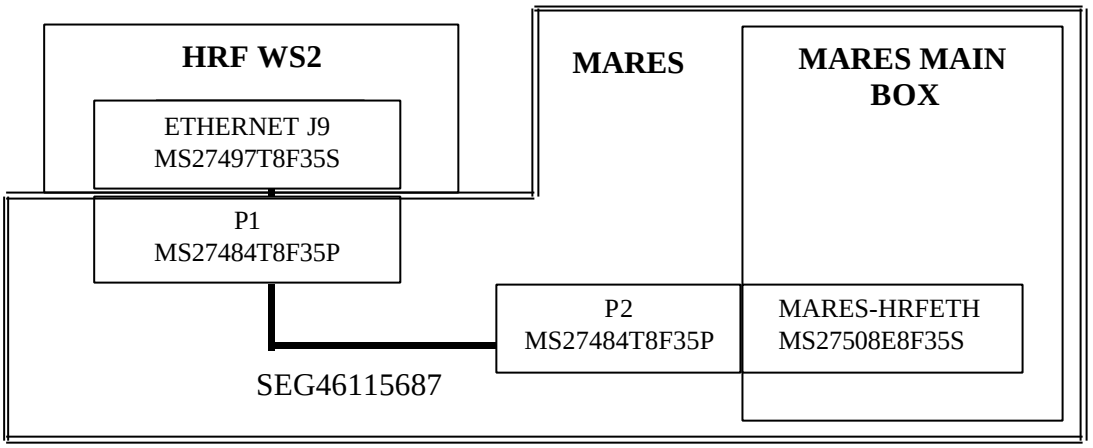


Figure 3-7: MARES to HRF Workstation 2 Ethernet Interface Diagram

HRFIS 3.2.3.2.1.1.1.10/H

MARES shall interface with the HRF Workstation 2 Ethernet port through a standard harness 8 feet long, SEG46115687 as defined in LS-71098 Document, provided by HRF. This length assumes that the MARES Rack and the HRF Rack will be adjacent.

HRF shall make provisions to supply a longer cable if the MARES Rack and the HRF Rack are not adjacent.

HRFIS 3.2.3.2.1.1.1.20/M

The MARES-HRFETH connector in the MARES Main Box Connector Panel is defined in Table 3-8.

Table 3-8: Ethernet Connector MARES-HRFETH.

Connector name:	**Type:**	**Features:**
MARES-HRFETH	MS27508E8F35S	MIL-C-38999 Female connector, 6 pins #22 (Series II)

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	HRF Ethernet TX+	Ethernet	RF	IEEE 802.3 i 10-BASE-T Ethernet/ IEEE 802.3 u 100-BASE-Tx Ethernet Automatic sensing	Ethernet channel TX
2	HRF Ethernet RX Shield				
3	HRF Ethernet RX+	Ethernet	RF		Ethernet channel RX
4	HRF Ethernet RX-	Ethernet	RF		Ethernet channel RX
5	HRF Ethernet TX-	Ethernet	RF		Ethernet channel TX
6	HRF Ethernet TX Shield				

HRFIS 3.2.3.2.1.1.1.30/H

The harness description corresponding to P/N SEG46115687 is presented in Table 3-9.

Table 3-9: SEG46115687 Ethernet cable

Connector name:	**Type:**	**Type:**	**Connector name:**
MARES-HRFETH	MS27484T8F35P	MS27484T8F35P	HRF WS2 ETHERNET J9
MIL-C-38999 Male connector, 6 pins #22 (Series II)		MIL-C-38999 Male connector, 6 pins #22 (Series II)	

Connector pin out P1			**Connector pin out P2**	
Pin Num	**Signal**	**Description**	**Signal**	**Pin Num**
1	TX+		RX+	3
2	RX Shield		RX Shield	2
3	RX+		TX+	1
4	RX-		TX-	5
5	TX-		RX-	4
6	TX Shield		TX Shield	6

HRFIS 3.2.3.2.1.1.1.40/B

The network protocol will be TCP/IP.The data to be transferred shall be grouped in the following two categories:

- Files transfer: includes MARES software updating, up-loading of experiments and down-loading of experiment related data
- On line data transfer: real time transmission of experiment and Health & Status (H&S) data for downlink purposes by HRF. H&S data (e.g. internal temperatures, voltages, fan speed etc.) may be provided in the same packet as experiment (science) data. HRF will provide software to extract the H&S data from the on-line data for transmission or display, if required.

3.2.3.2.2 MARES IP addresses

The IP addresses for HRF Rack 1 and Rack 2 MARES related systems are shown in Table 3-10.

Table 3-10: IP Adresses and Subnet Masks

	HRF Workstation 2 FP	Portable computer	MARES
Rack 1 IP Address	10.12.13.251	10.12.12. 21	10.12.13.220
Rack 1 Subnet Mask	255.255.0.0	255.255.0.0	255.255.0.0
Rack 2 IP Address	10.12.13.252	10.12.16.21	10.12.13.220
Rack 2 Subnet Mask	255.255.0.0	255.255.0.0	255.255.0.0

Note: MARES interface is the HRF Workstation 2 Front Panel (FP).

HRFIS 3.2.3.2.2.1.1.10/B

MARES shall be able to communicate with the HRF Workstation 2 and Portable Computer using the IP addresses and subnet masks defined in Table 3-10.

HRFIS 3.2.3.2.2.1.1.20/B

The MARES IP address seen from HRF shall be as per Table 3-10. The MARES IP address shall be stored in a configuration file. In this document all references to this address will be MARES_HRF_IP.

Although the MARES IP address is a fixed value, if needed, the possibility exists to modify this address. In order to change the MARES_HRF_IP the following steps shall be performed:

1. Update the MARES configuration file (IP_MARES.add) located in the MARES hard disk:
   1.1. Connect the MARES hard disk to the HRF Workstation 2.
   1.2. Edit the configuration file (ASCII file) in \Maressys\PCUS\IP_MARES.add
   1.3. Change the IPAddress entry value and save.
   1.4. Connect the MARES hard disk back to MARES.
2. Update the MARES application system configuration file (systemconfig.cfg) located in the HRF portable computer:
   2.1. Switch on the HRF Portable computer.
   2.2. Using Windows Explorer go the MARES directory.

2.3. Edit the MARES system configuration file (ASCII file) Systemconfig.cfg.

2.4. Change the IPAddress entry value and save.

The new configuration will take effect at MARES start-up.

3.2.3.2.3 MARES-HRF file transfer

Through this interface it will be possible to maintain the MARES Hard disk, updating the MARES SW, storing new experiments files, and retrieving the data files obtained in experiments previously executed.

HRFIS 3.2.3.2.3.1.1.10/M

In order to make the MARES Hard Disk contents available to HRF, MARES shall provide a File Transfer Protocol (FTP) server. This FTP server shall support the following commands suggested by RFC-959 for minimal FTP server implementation.

- HELP –List supported commands
- USER- Verify user name
- PASS –Verify password for the user
- QUIT – Quit the session
- LIST - List out contents of directory
- NLST -List directory contents using a concise format
- RETR –Retrieve a file
- STOR -Store a file
- CWD - Change working directory
- TYPE - Change data representation type
- PORT - Change the port number
- PWD - Get the name of current working directory
- STRU - Change file structure settings
- MODE - Change file transfer mode
- ALLO - Reserve sufficient storage
- ACCT - Identify the users account
- PASV -Make the server listen on a port for data connection
- NOOP -DO nothing

HRFIS 3.2.3.2.3.1.1.20/M

It will be possible to connect to this server with any user name and password including the standard anonymous connection. This server will be accessible by an FTP client at the IP address stated for the HRF connection **MARES_HRF_IP** (see section 3.2.3.2.2).

3.2.3.2.4 MARES file system

MARES SW applications rely on the existence of a MARES File System (MFS) storing all MARES software executable files, configuration data, experiment definition files and other data within the fixed logical directory and file structure next defined.

MARES has two 36 Gbytes SCSI Hard Disks removable units, that will be used as follows:

HRFIS 3.2.3.2.4.1.1.10/B

The SCASI IDs corresponding to the two removable Hard Disks units are 0 and 3, respectively.

HRFIS 3.2.3.2.4.1.1.20/M

MARES shall divide each disk in partitions, building on each partition a DOS file system, FAT 16 compatible with MS-DOS versions up to and including 6.2, supporting filenames length up to 40 characters.

HRFIS 3.2.3.2.4.1.1.30/M

For one HD, the first partition shall be reserved to the system files. This partition, named MARESSYS, will have the basic directories structure shown in Table 3-11:

Table 3-11: MARES System Files

MARESSYS	PCUS	PCUS executables and system configuration files		
	UIS	UIS executables, system configuration files, Crew Member Database		
	Templates	Experiments	Pre-defined Experiment Templates	
		Profiles	Pre-defined Profile Templates	
		Ref Docs	Reference Documentation templates	
		Tables	Pre-defined Tables templates	
		Batch_files	Batch files created for troubleshooting	
		…		
	Temporal	Ipp_files	Files archived for ipp.	
		Log_files	MARES Log files	
	User_templates	Templates defined by the user		
	Permanent_Data	Experiment 1	Subject Name 1	Permanent data
		…	…	
		Experiment N	Subject Name N	Permanent data

NTE will implement MARESSYS in the SCSI HD with ID #0

HRFIS 3.2.3.2.4.1.1.40/M

All the other partitions shall have the structure presented in Table 3-12 and will be used for experiments (definition and data) storage and will be named (volume name) as MARESD00 to MARESDXX.

Table 3-12: Other disk partitions structure

MARESD0n	Experiments	Experiment 1	Definition	Experiment procedures, profiles, waves, tables, data pool configuration, etc.
			Temporal_data	Temporal storage of data to be later moved to the HRF Workstation 2 for down-link
		Experiment 2	Definition	

			Temporal_data	
		...		

Data resulting from the definition of a given experiment will be stored, under a dedicated directory for that experiment. During the experiment's execution, this data will be picked up and used to control the motor appropriately.

HRFIS 3.2.3.2.4.1.1.50/M

The relevant scientific data obtained during the experiment's execution will be stored under the experiment's directory at the folder Temporal_data\SubjectName\Exptime, where "Exptime" is the date+time at which the experiments run starts in the following format:

DDmmmyyyy[HHhMMmSSs] (f.i. 03Dec2000[14h23m05s]).

In case that the SubjectName has blank spaces MARES shall replace them by the underscore character "_".

These files will contain a stream of experiment packets with the same format that the ones defined for HRF on line data transfer (See next section 3.2.3.2.5).

HRFIS 3.2.3.2.4.1.1.60/M

The maximum file size allowed is 1.4Mbytes. The files will be named with the daytime at which the oldest data they contain was acquired.

The format will be HHhMMmSS. Being the characters "h"; "m" separators (f.i. 23h04m35.dlk)
The filename extension will be "dlk".

3.2.3.2.5 MARES-HRF on line data transfer

HRFIS 3.2.3.2.5.1.1.10/B

During the execution of experiments MARES will transmit to HRF the experiment related data, using TCP/IP stream socket protocol in a client/server configuration, with an average throughput of 100 Kbytes/s in 5 seconds. The maximum throughput will be limited by the 10-base Ethernet standard.

HRFIS 3.2.3.2.5.1.1.20/B

MARES will act as server waiting (listen) for the HRF (client) connection at the IP address **MARES_HRF_IP** port number 2000.

HRFIS 3.2.3.2.5.1.1.30/M

MARES will support the connection of only one client at a time.

HRFIS 3.2.3.2.5.1.1.40/B

During HRF client connection, MARES will, at worst case, continuously send the experiment data packets.

HRFIS 3.2.3.2.5.1.1.50/M

Simultaneously with the experiment execution MARES will store the experiment data packets in its Hard Disk independently if an HRF connection is done active or not. This will allow HRF to recover the data by FTP (see section 3.2.3.2.3) in case of transmission error or no connection during experiment execution.

3.2.3.2.6 Experiment Data packets

The data packet defined in this section has been designed in order to accommodate the following kind of data:

- High sampling rate data, up to 4KHz.
- Low sampling rate data, below 1Hz.
- Trigger signals: Digital signals that only change one time every several seconds, but with synchronisation constraints of 1 millisecond.
- 16 bits wide data
- 32 bits wide data
- Strings

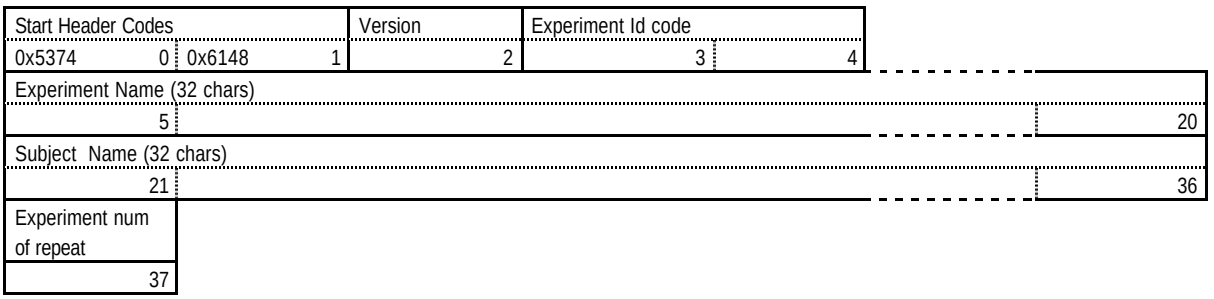
Other constraints:

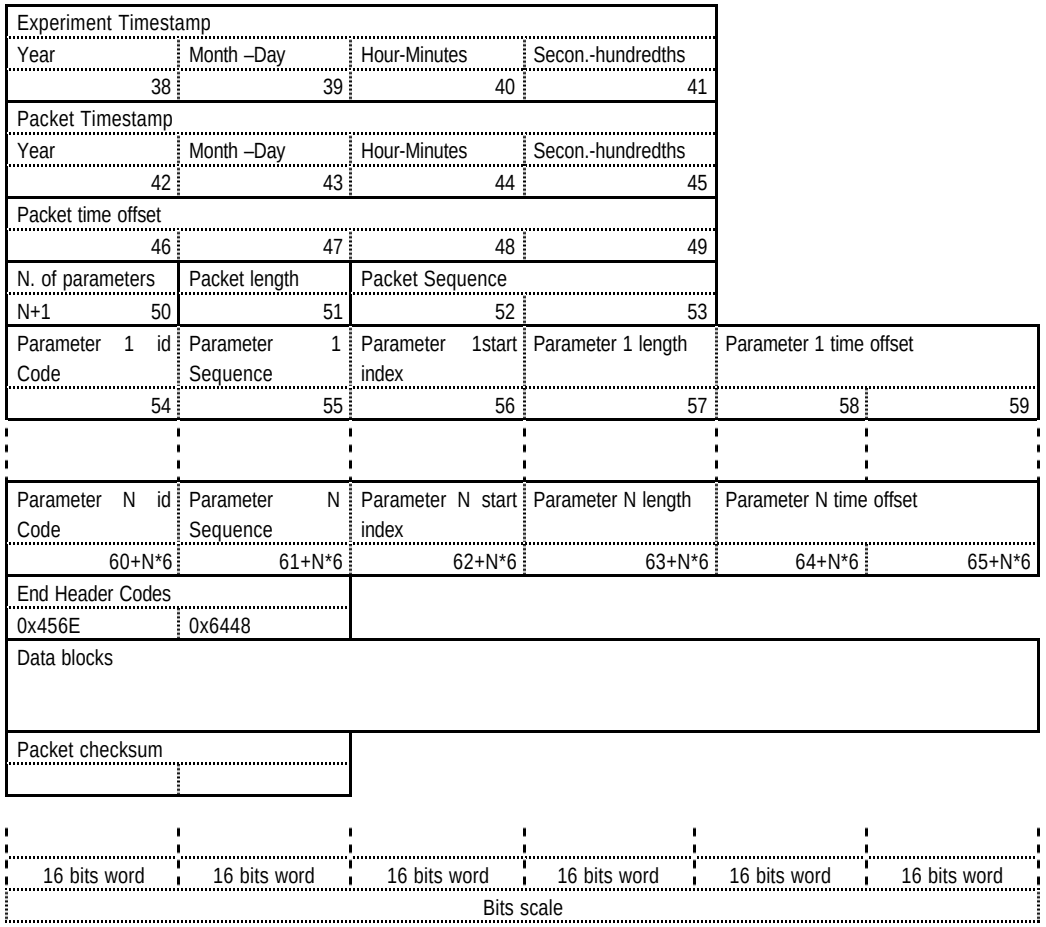
- Only a subset of all MARES related data will be transmitted/stored for one specific experiment.
- The sampling rate and the acquisition time slots of each data are experiment specific.
- For each experiment it is possible to define new signals (user defined, unknown at MARES design time)
- The Synchronisation among the data corresponding to different signals must be kept inside 1milisecond for sampling rates over 1KHz and trigger signals, and a half of the sampling period for the others.

The MARES Experiment Data Packet does not have either fixed length or a fixed format, as it is experiment dependent.

HRFIS 3.2.3.2.6.1.1.10/M

Each MARES experiment data packet will have a header defining the packet contents followed by a data block containing the experiment data with the following format:





Where:

- Start Header Codes: 32 bits code identifying the beginning of a packet. This code corresponds to the ASCII characters “StaH”
- End Header Codes: 32 bits code identifying the end of a header. This code corresponds to the ASCII characters “EndH”
  The aim of the previous codes is to allow the recovery of the data from damaged files. It may be used as packet synchronism flags. The possibility that in the packet body it exists the same codes in the same sequence and with the same separation between the Start Header Codes and the End Header Codes is very low
- Version: 16 bits identifying the packet version, BCD coded. It will start at version 1.0 to be coded as 0x0100
- Experiment Id code: 32 bits identifying the experiment
- Experiment Name: The first 32 characters of the experiment name
- Subject Name: the first 32 characters of the subject name
- Experiment num of repeat: number of times the experiment has been executed by the present subject
- Experiment Timestamp: Absolute time at which the experiment started. In the format defined in the definition of Packet Timestamp

- Packet Timestamp: Absolute time at which the first parameter was acquired and added to the packet
- This timestamp will contain the year, month, day, hour, minutes, second and second hundredths coded in BCD.
- For example the date/time 11:58:23,89 of the 1998-12-28 will be coded as

Timestamp (64 bits)							
Year		Month –Day		Hour-Minutes		Second-hundredths	
0x19	0x98	0x12	0x28	0x11	0x58	0x23	0x89

At MARES power on the time/data of MARES will be synchronised with the time/data of the Thinkpad (PCS) connected to MARES.

- Packet time offset: 64 bits double giving the time (in microseconds) between the start of the experiment and the time point in which the firts parameter of the packet was acquired.
- N. of parameters: 16 bits unsigned integer giving the number of parameters inside the packet
- Packet length: 16 bits unsigned integer giving the number of 16-bits word of the packet. It includes the packet header and the Packet checksum bytes. The overall packet length is limited to 2*2^16 ≅130Kbytes.
- Packet Sequence: 32 bits unsigned integer giving the packet sequence number. This sequence number will be restarted to zero at each start experiment execution and increased by one at each new packet. In case of overflow this number will be restarted.
  For each parameter in the packet the following 6 words will be added to the header

Parameter id Code	Parameter Sequence	Parameter start index	Parameter length	Parameter time offset	

- Parameter id Code: 16 bits code identifying the parameter. These codes will be built at experiment definition time. The high nibble will identify the type of parameter as follows:

0x0XXX	8 bits ASCII character
0x1XXX	8 bits unsigned
0x2XXX	8 bits signed
0x3XXX	16 bits signed integer
0x4XXX	16 bits unsigned integer
0x5XXX	32 bits signed integer
0x6XXX	32 bits unsigned integer
0x7XXX	32 bits float
0x8XXX	64 bits signed integer
0x9XXX	64 bits unsigned integer
0xaXXX	64 bits float (double)
0xbXXX	String of ASCII characters

0xcXXX	Digital signal (8 bits coded: 0 for zero, any other code for one)
0xdXXX	Digital signal (1 bit coded)
0xeXXX	Timestamp
0xfXXX	Unused

This identification code assignment mechanism allows 4096 different parameters of each type.

- Parameter Sequence: 16 bits unsigned integer giving the count of the parameter presence in the transmission packets. At experiment start and at overflow the sequence count will be reset to zero. At each presence of the parameter in a packet the Parameter Sequence will be increased by one.
- Parameter start index: 16 bits unsigned integer giving the offset, in 16 bits words from the beginning of the packet header, to the first value of the parameter.
- Parameter length: 16 bits unsigned integer giving the number of samples of the parameter contained in the packet. The number of bytes or words will depend of the kind of parameter (see Parameter id Code)
- Parameter time offset: 32 bits unsigned integer giving the time offset (in microseconds) from the Packet time offset to the time at which the first sample of the parameter on the packet was acquired.
- Packet checksum: 32 bits unsigned integer giving the checksum of the entire packet excluding only the checksum itself.
- Data block: contains the sampled values of the parameters organised as defined in the packet header.

HRFIS 3.2.3.2.6.1.1.20/M

The packet checksum will be calculated with the following algorithm:

Definitions:

p_Pbuffer: pointer to the packet data buffer

packet length: unsigned short integer 16-bits wide indication the number of 16-bits words of the packet

```
unsigned short int * p_ usPackBuff;          //pointer to 16-bits wide unsigned integer
unsigned int chksum;                         //unsigned integer 32-bits wide to store the result of the calculus
unsigned int t;                              // auxiliary variables
unsigned int temp;                           //auxiliary variables
p_ usPackBuff=(unsigned short int*) p_Pbuffer;
chksum=0;                                    //initialisation
for(t=1;t< packet length-1; t++)             //for all the packet words excluding the checksum ones
        {
        temp=(unsigned int)*p_usPackBuff;
        temp=temp*t;
        chcksum=chksum+temp;
```

```
p_usPackBuff++;
}
```

HRFIS 3.2.3.2.6.1.1.30/M

All the parameters will be transmitted in the Big Endian format (Motorola, Network standard).

HRFIS 3.2.3.2.6.1.1.40/M

The samples corresponding to parameters of type string will be separated in the parameter data block with the "C" standard string terminator.

HRFIS 3.2.3.2.6.1.1.50/M

All data blocks corresponding to a parameter will start and finish16-bits words aligned. In case of a data block finished in the middle of a 16-bits word the remaining bits will be padded with the value 0b.

3.2.3.2.7 Experiment packet definition file

HRFIS 3.2.3.2.7.1.1.10/M

For each experiment it will exist an ASCII file automatically created at experiment programming time with the filename **ExpPack.def** defining the identification codes of each parameter able to be transmitted, their sampling rate, type, units and scale.

HRFIS 3.2.3.2.7.1.1.20/M

These files will be formatted as follows:

For each parameter the file will contain a line like

Parameter_label: Parameter id Code; Sampling rate; Offset factor; Scale Factor; Units.

Where:

- Parameter id Code: Four ASCII characters with the identification code corresponding to the parameter in hexadecimal format. Each code must be unique in the entire file and must be built using the parameter type coding mechanism described in the previous section.
- Sampling Rate: Sampling rate at which the parameter will be transmitted in Hz coded in decimal.
- Offset factor: Offset factor to be applied to the transmitted raw data in order to obtain the parameter value in the defined units.
- Scale factor: Scale factor to be applied to the transmitted raw data in order to obtain the parameter value in the defined units.

- Units: Label identifying the units of the parameter. After applying to the transmitted raw data the Offset and the Scale factors the obtained value will have these units.

For example a file containing the following two lines:

Position: 3001;1000;0;0.012;degrees

Torque:3002;4000;0;0.03125;Nm

Corresponds to an experiment where two parameters are transmitted:

- "Position" with an identification code of 3001 hexadecimal, which means that the parameter is transmitted as a 16 bits integer. This parameter is transmitted at 1KHz and after applying an offset of zero and a scale factor of 0.012 the value obtained will be in degrees.
- "Torque" with an identification code of 3002 hexadecimal, which means that the parameter is transmitted as a 16 bits integer. This parameter is transmitted at 4KHz and after applying an offset of zero and a scale factor of 0.003125 the value obtained will be in Nm.

Note: this information can be included in the MARES data dictionary, with ref. MARES-0000-TN-230-NTE.

3.2.3.2.8 NFS client installation/configuration

Although the file transfer between MARES Portable computer and MARES Main Box through the NFS is an internal interface it is defined here because HRF will provide the NFS client.

HRFIS 3.2.3.2.8.1.1.10/B

The Network File System (NFS) to be installed and configured by HRF on the Portable Computers to be used with MARES shall be the ViewNow **InterDrive Client v7.0** from NetManage.

The details related with its installation and configuration are stated in the Software User's Manual.

3.2.3.2.9 MARES to HRF Removable HD Command and Data Handling Interface (MARES-HD-SW)

HRFIS 3.2.3.2.9.1.1.10/M

MARES shall provide a connector for the HRF SCSI Removable Hard Disks compatible with the electrical and data signals defined in NASA drawing SEG46117769, issue NC, dated 19/03/01. This connector, defined in Table 3-13, shall have the followig characteristics:

Table 3-13: MARES-HDSCASI connector characteristics

Connector name	Type	Features	Remarks
MARES-HDSCSI	WGX80SAD11SY	PCB, 3 row, receptacle, straight, 80 sockets	
Connector pin out			
SE-SCSI signal	WGX80 Pin Num	SE-SCSI signal	WGX80 Pin Num
GND_DB12	58	DB12-	57
GND_DB13	2	DB13-	28
GND_DB14	3	DB14-	29
GND_DB15	4	DB15-	30
GND_DBPH	5	DBPH-	31
GND_DB0	6	DB0-	32
GND_DB1	7	DB1-	33
GND_DB2	8	DB2-	34
GND_DB3	9	DB3-	35
GND_DB4	10	DB4-	36
GND_DB5	11	DB5-	37
GND_DB6	12	DB6-	38
GND_DB7	13	DB7-	39
GND_DBP	14	DBP-	40
GND	65	GND	76
DIFFSENSE	60	GND	77
TERMPWR	61	TERMPWR	62
TERMPWR	63	TERMPWR	64
RESERVED	74	RESERVED	73
GND	72	GND	78
GND_ATN	15	ATN-	41
GND	75	GND	79
GND_BSY	16	BSY-	42
GND_ACK	17	ACK-	43
GND_RST	18	RST-	44
GND_MSG	19	MSG-	45
GND_SEL	20	SEL-	46
GND_C/D	21	C/D-	47
GND_REQ	22	REQ-	48
GND_I/O	23	I/O-	49
GND_DB8	24	DB8-	50
GND_DB9	25	DB9-	51
GND_ DB10	26	DB10-	52
GND_ DB11	27	DB11-	53
		+5V	54
		+12V	68
NC	*	GND PS	56, 70

*Pins NC in Airborn-WGX80: 1, 55, 59, 66, 67, 69, 71, 80.

NOTE: SCASI HDs operate in MARES in single-ended mode since DIFFSENSE voltage is always set below 0.7V. SCASI HDs operate in differential mode when mounted in HRF WS2.

3.2.3.3 MARES to External Devices Command and Data Handling Interface (MARES-ExD-SW)

3.2.3.3.1 MARES General Purpose Interface

MARES will provide general-purpose inputs and outputs for data acquisition and control from/to external instrumentation:

- Two serial channels
- Eight analogue inputs
- Two trigger inputs
- Two trigger outputs
- Two digital outputs
- A normaly closed contact activated with the MARES emergency stop button

These signals shall be available through the connectors defined in Table 3-14, located in the Main Box connector panel:

Table 3-14: MARES General Purpose Interface Connectors

Connector name	**Type**	**Features**		
MARES-ED2A	MS27508E12F35SA	Analog in #0-3		
		Trigger in/out #1		
Connector name	**Type**	**Features**		
MARES-ED3A	MS27508E12F35SA	Analog in #4-7		
		Trigger in/out #2		
Connector name	**Type**	**Features**		
MARES-ED4A	MS27508E12F35S	Serial #1 RS422	Trigger in/out #1	
		Serial #1 RS232	Digital out #1	Parameter Setting #1
Connector name	**Type**	**Features**		
MARES-ED5A	MS27508E12F35S	Serial #2 RS422	Trigger in/out #2	
		Serial #2 RS232	Digital out #2	Parameter Setting #2
Connector name	**Type**	**Features**		
MARES-ED6A	MS27508E12F35SB	Serial #1 RS422	Trigger in/out #1	
		Stop pushbutton	Trigger in/out #2	

The following tables specify the MARES connectors type and pin-out:

HRFIS 3.2.3.3.1.1.1.10/M

Connector name	Type	Features
MARES-ED2A	MS27508E12F35SA	Analog in #0-3 Trigger in/out #1

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4				
5		ExtAnalog0+	Analogue/in	±10 Volts/16bits Zin>1MΩ
6		ExtAnalog0-	Analogue/in	±10 Volts/16bits Zin>1MΩ
7		Chassis ground		
8		ExtAnalog1+	Analogue/in	±10 Volts/16bits Zin>1MΩ
9		ExtAnalog1-	Analogue/in	±10 Volts/16bits Zin>1MΩ
10		Chassis ground		
11		ExtAnalog2+	Analogue/in	±10 Volts/16bits Zin>1MΩ
12		ExtAnalog2-	Analogue/in	±10 Volts/16bits Zin>1MΩ
13		Chassis ground		
14		ExtAnalog3+	Analogue/in	±10 Volts/16bits Zin>1MΩ
15		ExtAnalog3-	Analogue/in	±10 Volts/16bits Zin>1MΩ
16		Chassis ground		
17		TriggIn1+	RS 422/in	TIA/EIA-422-B
18		TriggIn1-	RS 422/in	TIA/EIA-422-B
19		Chassis ground		
20		TriggOut1+	RS 422/out	TIA/EIA-422-B
21		TriggOut1-	RS 422/out	TIA/EIA-422-B
22		Chassis ground		

HRFIS 3.2.3.3.1.1.1.20/M

Connector name	Type	Features
MARES-ED3A	MS27508E12F35SA	Analog in #4-7 Trigger in/out #2

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4				
5		ExtAnalog4+	Analogue/in	±10 Volts/16bits Zin>1MΩ
6		ExtAnalog4-	Analogue/in	±10 Volts/16bits Zin>1MΩ
7		Chassis ground		
8		ExtAnalog5+	Analogue/in	±10 Volts/16bits Zin>1MΩ
9		ExtAnalog5-	Analogue/in	±10 Volts/16bits Zin>1MΩ
10		Chassis ground		
11		ExtAnalog6+	Analogue/in	±10 Volts/16bits Zin>1MΩ
12		ExtAnalog6-	Analogue/in	±10 Volts/16bits Zin>1MΩ
13		Chassis ground		
14		ExtAnalog7+	Analogue/in	±10 Volts/16bits Zin>1MΩ
15		ExtAnalog7-	Analogue/in	±10 Volts/16bits Zin>1MΩ
16		Chassis ground		
17		TriggIn2+	RS 422/in	TIA/EIA-422-B isolated
18		TriggIn2-	RS 422/in	
19		Chassis ground		
20		TriggOut2+	RS 422/out	TIA/EIA-422-B
21		TriggOut2-	RS 422/out	TIA/EIA-422-B
22		Chassis ground		

HRFIS 3.2.3.3.1.1.1.30/M

Connector name	Type	Features
MARES-ED4A	MS27508E12F35S	Serial #1 RS422 Trigger in/out #1 Serial #1 RS232 Digital out #1 Parameter Setting #1

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4	22D	422 TX1+	RS 422/out	TIA/EIA-422-B
5	22D	422 TX1-	RS 422/out	TIA/EIA-422-B
6	22D	422 RX1+	RS 422/in	TIA/EIA-422-B isolated
7	22D	422 RX1-	RS 422/in	
8	22D	Chassis ground		
9	22D	RS 232 Rx1	RS-232/in	TIA/EIA-232-F. Isolated
10	22D	RS 232 Tx1	RS-232/out	TIA/EIA-232-F.
11	22D	RS 232 GND		
12	22D	Chassis ground		
13	22D	TriggIn1+	RS 422/in	TIA/EIA-422-B isolated
14	22D	TriggIn1-	RS 422/in	
15	22D	TriggOut1+	RS 422/out	TIA/EIA-422-B
16	22D	TriggOut1-	RS 422/out	TIA/EIA-422-B
17	22D	DigOut1+	RS 422/out	TIA/EIA-422-B
18	22D	DigOut1-	RS 422/out	TIA/EIA-422-B
19	22D	Chassis ground		
20	22D	Set_par1+	Analogue/in	±10 Volts/16bits Zin>1MΩ
21	22D	Set_par1-	Analogue/in	±10 Volts/16bits Zin>1MΩ
22	22D	Chassis ground		

HRFIS 3.2.3.3.1.1.1.40/M

Connector name	Type	Features
MARES-ED5A	MS27508E12F35S	Serial #2 RS422 Trigger in/out #2 Serial #2 RS232 Digital out #2 Parameter Setting #2

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4	22D	422 TX2+	RS 422/out	TIA/EIA-422-B
5	22D	422 TX2-	RS 422/out	TIA/EIA-422-B
6	22D	422 RX2+	RS 422/in	TIA/EIA-422-B isolated
7	22D	422 RX2-	RS 422/in	
8	22D	Chassis ground		
9	22D	RS 232 Rx2	RS-232/in	TIA/EIA-232-F. Isolated
10	22D	RS 232 Tx2	RS-232/out	TIA/EIA-232-F.
11	22D	RS 232 GND		
12	22D	Chassis ground		
13	22D	TriggIn2+	RS 422/in	TIA/EIA-422-B isolated
14	22D	TriggIn2-	RS 422/in	
15	22D	TriggOut2+	RS 422/out	TIA/EIA-422-B
16	22D	TriggOut2-	RS 422/out	TIA/EIA-422-B
17	22D	DigOut2+	RS 422/out	TIA/EIA-422-B
18	22D	DigOut2-	RS 422/out	TIA/EIA-422-B
19	22D	Chassis ground		
20	22D	Set_par2+	Analogue/in	±10 Volts/16bits Zin>1MΩ
21	22D	Set_par2-	Analogue/in	±10 Volts/16bits Zin>1MΩ
22	22D	Chassis ground		

HRFIS 3.2.3.3.1.1.1.50/M

Connector name	Type	Features
MARES-ED6A	MS27508E12F35SB	Serial #1 RS422 Trigger in/out #1 Stop pushbutton Trigger in/out #2

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4				
5	22D	422 TX1+	RS 422/out	TIA/EIA-422-B
6	22D	422 TX1-	RS 422/out	TIA/EIA-422-B
7	22D	422 RX1+	RS 422/in	TIA/EIA-422-B isolated
8	22D	422 RX1-	RS 422/in	
9	22D	Chassis ground		
10	22D	TriggIn1+	RS 422/in	TIA/EIA-422-B isolated
11	22D	TriggIn1-	RS 422/in	
12	22D	TriggIn2+	RS 422/in	TIA/EIA-422-B isolated
13	22D	TriggIn2-	RS 422/in	
14	22D	Chassis ground		
15	22D	TriggOut1+	RS 422/out	TIA/EIA-422-B
16	22D	TriggOut1-	RS 422/out	TIA/EIA-422-B
17	22D	TriggOut2+	RS 422/out	TIA/EIA-422-B
18	22D	TriggOut2-	RS 422/out	TIA/EIA-422-B
19	22D	Chassis ground		
20	22D	Stop pushbutton	N.C. Switch contact	Isolated (>1Mohm) Maximun current 0.1 Amps, Maximum voltage 28Vdc, 115Vac (60/400 Hz) Min open inpedance 1M ohms Max Close impedance 10 ohms
21	22D	Stop pushbutton ret	N.C. Switch contact	
22	22D	Chassis ground		

HRFIS 3.2.3.3.1.1.1.60/M

MARES shall place a resistor of 150 ohms between the positive and negative terminals of all (either digital or serial) input signals defined as TIA/EIA-422-B.

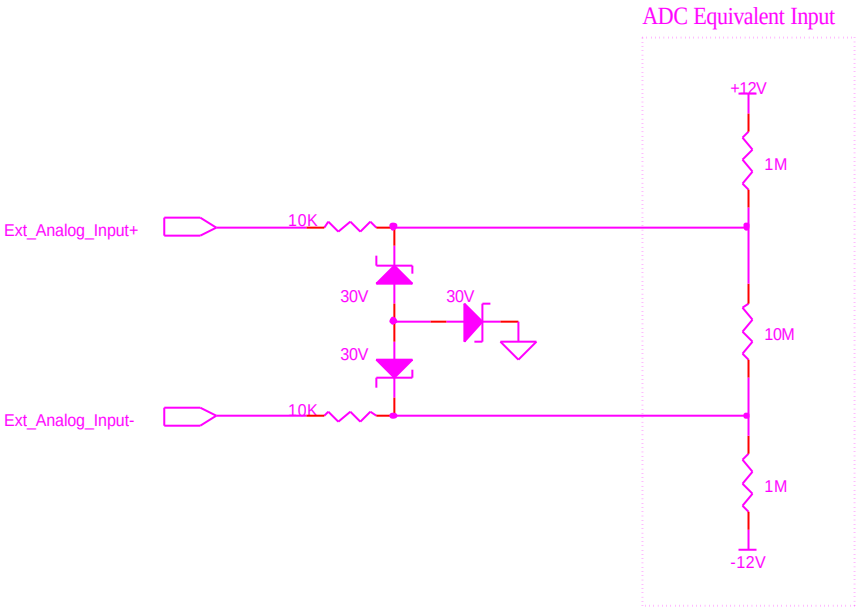
HRFIS 3.2.3.3.1.1.1.70/M

Trigger pulses shall be programmable to be either positive or negative, and to have a duration either fixed at 250 µs ± 10 µs, or variable

3.2.3.3.2 Analog inputs schematic

HRFIS 3.2.3.3.2.1.1.10/M

The equivalent circuit of the Analog inputs shall be the following



3.2.3.3.3 Serial Channels External Interface

Both serial channels will include Receiver and Transmit channels and both will be independently configurable by software to be RS-232 or RS-422 compatible.

It will be possible to send commands and download files through any of the two RS-232/422 external channels with the options and capabilities defined below.

It will be possible to receive data through any of the two RS-232/422 external channels with the options and capabilities defined below.

3.2.3.3.3.1 Physical Interface

MARES Experiment Editor shall allow the programming of the defined parameters HRFIS 3.2.3.3.3.1.1.10 to HRFIS 3.2.3.3.3.1.1.50 independently for each channel, but with the same setting for both transmission and reception, and fixed for the whole experiment.

HRFIS 3.2.3.3.3.1.1.10/M

In case of a serial channel configured as RS-232, MARES will support the following baudrates:

- 1200 bits/s
- 2400 bits/s
- 4800 bits/s
- 9600 bits/s
- 19200 bits/s

HRFIS 3.2.3.3.3.1.1.20/M

In case of a serial channel configured as RS-422, MARES will support the following baudrates:

- 1200 bits/s
- 2400 bits/s
- 4800 bits/s
- 9600 bits/s
- 19200 bits/s
- 38400 bits/s

HRFIS 3.2.3.3.3.1.1.30/M

For each RS-232/422 external channel, MARES will support the following parity options:

- No parity
- Even parity
- Odd parity

HRFIS 3.2.3.3.3.1.1.40/M

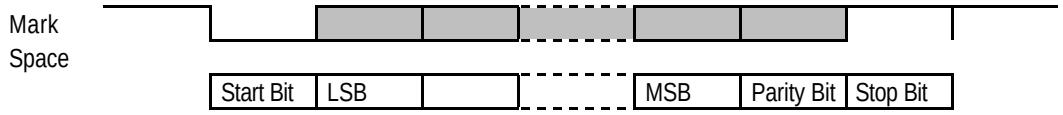
For each RS-232/422 external channel, MARES will support 1 or 2 stop bits.

HRFIS 3.2.3.3.3.1.1.50/M

For each RS-232/422 external channel, MARES will support characters length of 7 and 8 bits.

HRFIS 3.2.3.3.3.1.1.60/M

MARES will send and receive characters in the following format:



3.2.3.3.3.2 Interface Handshake Mechanism

HRFIS 3.2.3.3.3.2.1.10/M

During transmission, MARES shall not transmit more than three complete characters from the moment that receives the last stop bit of the XOFF control code character (19 dec/13 Hex) through the reception line of the same MARES channel.

MARES shall resume the transmission in less than 100 ms from the reception of the last stop bit of the XON control code (17 dec/ 11 Hex), without skipping nor repeating any character.

HRFIS 3.2.3.3.3.2.1.20/M

The MARES maximum waiting time between the XOFF and XON reception will be the equivalent to the transmission of 256 characters at the selected baudrate.

If the maximum waiting time expires, MARES will assume a transmission error, the current trasmission process (command or file) shall be aborted and the XON code will not be expected to start a new transmission process.

MARES shall discard any XON/ XOFF received out of sequence.

HRFIS 3.2.3.3.3.2.1.30/M

During reception, MARES will accept up to four received complete characters from the moment that MARES has transmitted the last stop bit of the XOFF control code (19 dec/13 HEX).

MARES shall continue accepting data immediately after MARES has transmitted the last stop bit of the XON control code (17 dec/ 11 Hex). These data shall be treated as a continuation of the interrupted data packet.

The MARES maximum delay time between the XOFF and XON transmission shall be the equivalent to the transmission of 256 characters at the selected baudrate.

Expired this waiting time, MARES shall discard the packet partially received and shall wait for the next packet.

3.2.3.3.3.3 Services

MARES supports three services through both serial channels available for external devices:

- Commanding service
- File download service
- Data acquisition service

3.2.3.3.3.3.1 Commanding service

HRFIS 3.2.3.3.3.3.1.10/M

MARES will be able to send commands to the external devices through the RS-232/422 external channels.

These commands will consist of a string of alphabetic characters, from the "A" to "Z" and from the "a" to "z", numeric, from "0" to "9" and space.

The maximum supported string length will be 10 characters.

MARES will send the commands, as it will be programmed, without adding, deleting or changing any character/code.

The transmission of any command shall not take longer than one and a half time the minimum transmission time for the given baud-rate.

MARES shall send the whole string command without introducing any control code inside (XON/XOFF).

MARES shall be programable so that the delay from receiving the last bit of an ACK to "Send command" until starting the file transfer be les than 4 s.

HRFIS 3.2.3.3.3.3.1.20/M

It will be possible to optionally program MARES to wait for acknowledge after a command transmission.

In this case, MARES will wait for the reception of the ACK control code (6 dec/6 Hex) or the NAK control code (21 dec/15 Hex) through the reception line of the same channel, during a programmable period of time. If the maximum waiting time will expire, MARES will assume a transmission error.

HRFIS 3.2.3.3.3.3.1.30/M

During the time that MARES waits for acknowledgement, MARES will not start the transmission of another command or download a file.

3.2.3.3.3.3.2 Files download service

HRFIS 3.2.3.3.3.3.2.10/M

MARES will be able to send files to the external devices through the RS-232/422 external channels.

The files will have a filename (DOS compatible) no longer than 8 characters and with the extension SER, with a maximum length of 200Kbytes.

MARES will send the file, as it will be, without adding, deleting or changing any character/code.

The transmission of the file shall be done in such way that the maximum time between two consecutive characters shall be less than the one corresponding to the transmission of 32 characters at the selected baud rate. And the total file transmission time less than one and a half the minimum transmission time.

HRFIS 3.2.3.3.3.3.2.20/M

It will be possible to optionally program MARES to wait for acknowledge after a file transmission.

In this case, MARES will wait for the reception of the ACK control code (6 dec/6 Hex) or the NAK control code (21 dec/15 Hex) through the reception line of the same channel, during a programmable period of the time.

If the maximum waiting time will expire, MARES will assume a transmission error.

HRFIS 3.2.3.3.3.3.2.30/M

During the time that MARES waits for acknowledgement, MARES will not start the transmission of another command or download a file.

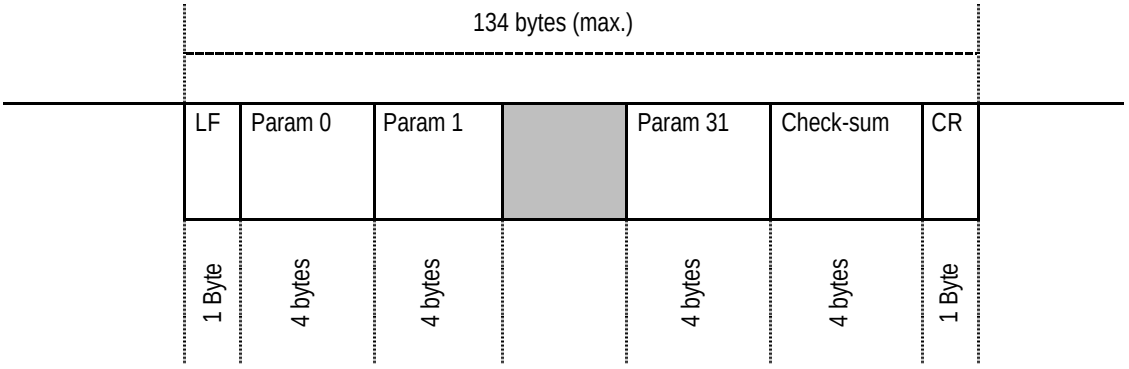
3.2.3.3.3.3 Serial data acquisition

HRFIS 3.2.3.3.3.3.3.10/M

MARES shall acquire from the external devices using the fix Serial Data Acquisition Packet defined herafter.

MARES shall be able to acquire any number of parameters between 1 and 32. The number of parameters will be defined at experiment level and will remain fix along the experiment

Serial Data Acquisition Packet:



Where:

- LF: Start packed control code (10 dec/0A Hex).
- CR: End packed control code (13 dec/0D Hex).

MARES shall decode each 16 bits parameter and the checksum as a string of 4 ASCII characters corresponding to the hexadecimal representation of the parameter.

For example a parameter with a value of 11223 decimal will be sent as the string “2BD7”.

The first character to be sent will be the one corresponding to the most significant nibble.

The hexadecimal representation will be in capital letters and numbers.

The checksum will be calculated as the sum module 16 bits of the transmitted string corresponding to the parameters 0 to 31. The start packed and end packed control codes will not be included in the checksum calculus.

In the internal Data Pool and for downlink/archive, MARES shall handle the value of these parameters as unsigned integers, between 0 and 65535 (16 bits).For real-time display and processing (LabView), MARES shall handle these parameters either as unsigned integers, 16 bit Hexadecimal words, individual Boolean bits, and any other data format supported by LabView.

For calculation in an Experiment Procedure step, MARES shall handle these parameters as 16-bit unsigned integers (although internally MARES uses floating point), with the following comparison operators: <, >, =, <=, >=, and <>.

MARES shall not take more than 2 seconds from the transmission of the last bit of the Status TM until the value of the parameters is available in the Data Pool.

HRFIS 3.2.3.3.3.3.3.20/M

MARES will support a continuous acquisition of 1Kbyte/s as a global throughput for the two serial interfaces.

HRFIS 3.2.3.3.3.3.3.30/M

In case of transmission error detection, MARES will maintain the parameters values of the last correct received packed.

MARES shall have a counter counting the time since the last packet was correctly received. This counter shall be in seconds, rounding-up as a 16-bits word, and it shall be accessible as a Data Pool variable. Each time a new data packet frame is correctly decoded MARES shall reset this counter to zero.

HRFIS 3.2.3.3.3.3.3.40/M

MARES shall be able to perform the Serial Data Acquisition service simultaneously with the performance of the Commanding and File Transfer services.

3.2.3.3.4 Analogue Inputs

HRFIS 3.2.3.3.4.1.1.10/M

MARES shall provide eight analogue inputs for signal acquisition with the following characteristics:

- Differential input
- ± 10 volts input range
- ± 20 volts maximum input voltage
- Differential input impedance higher than 1 Mohm.
- Common mode impedance higher than 1 Mohm.
- 2 KHz analogue bandwidth at –3 dB

- 16 bits resolution

3.2.3.3.5 Parameter Set Inputs

HRFIS 3.2.3.3.5.1.1.10/M

MARES shall provide two analogue inputs for parameter setting with the following characteristics:

- Differential input
- ± 10 volts input range
- ± 20 volts maximum input voltage
- Differential input impedance higher than 1 Mohm
- Common mode impedance higher than 1 Mohm
- 50 Hz analogue bandwidth at –3 dB
- 16 bits resolution

3.2.3.4 MARES-Test-SW

Through this interface it will be possible to monitor the Controller Electronics power supply, and the time base used by MARES.

The interface will consist of four BNC connectors (MARES-TC1A to MARES-TC4A) defined in HRFIS 3.2.3.4.1.1.1.10 to HRFIS 3.2.3.4.1.1.1.40, compatible with the Scopemeter Assembly defined as part of the Diagnostic Caddy as common hardware in the Common Hardware Implementation Plan (CHIP) for the Human Research Facility LS-71098 document.

In addition, two serial lines accessed through connectors MARES-TC5A and MARES-TC6A defined in 00 are also provided for troubleshooting purposes.

In order to access these connectors it shall be necessary to remove the MARES back cover.

HRFIS 3.2.3.4.1.1.1.10/M

Connector name:	**Type:**	**Features:**
MARES-TC1A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	CE+5Mon	Analogue/out	ML	Nominal value = 5Volt	CE +5 PS monitoring
2	CE+5Mon Ret				

HRFIS 3.2.3.4.1.1.1.20/M

Connector name:	Type:	Features:
MARES-TC2A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	CE+12Mon	Analogue/out	ML	Nominal value = 12Volt	CE +12 PS monitoring
2	CE+12Mon Ret				

HRFIS 3.2.3.4.1.1.1.30/M

Connector name:	Type:	Features:
MARES-TC3A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	CE-12Mon	Analogue/out	ML	Nominal value = -12Volt	CE –12 PS monitoring
2	CE-12Mon Ret				

HRFIS 3.2.3.4.1.1.1.40/M

Connector name:	Type:	Features:
MARES-TC4A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	4K clock	Digital signal, VH = 3 Volts VL = 1 Volt	RF	Nominal value=4 KHz	Time base monitoring
2	4K clock ret				

HRFIS 3.2.3.4.1.1.1.50/M

Serial lines shown below shall be compatible with the HRF PCS, ComCard232/422/485/2 PCMCIA card connector.

Connector name	Type	Features	Remarks
MARES-TC5A	DBEE 1031Z012-130	Receptacle, 12 male pins	Serial RS232 Debug Chanel from MASTER CPU
MARES-TC6A	DBEE 1031Z012-130	Receptacle, 12 male pins	Serial RS232 Debug Chanel from SLAVE CPU

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	Controller RST	TTL IN	HO	Connect the two signals to reset the CE	Controller reset. To be used only during development
2	Controller RST ret	GND			
3	Not connected				
4	Not connected				
5	Not connected				
6	Chassis ground				
7	Not connected				
8	Not connected				
9	Not connected				
10	RS 232 Rx	RS232/IN		RS232 serial channel: 9600, 8 bits, No parity, 1 stop bit	Serial debug and troubleshooting channel
11	RS 232 Tx	RS232/OUT			
12	RS 232 GND				

3.2.4 Audio/Video Interfaces

Not applicable

3.2.5 Thermal Control Interfaces

Not applicable

3.2.6 Waste Gas Vent and Vacuum Interfaces

Not applicable

3.2.7 Nitrogen Interfaces

Not applicable

3.2.8 Fire Detection Interface

MARES shall use the ISS module area smoke detector for fire detection.

4. APPENDIX 1

The purpose of Table 4-1 is to define the provision responsibility of the various MARES Payload and MARES Rack related items, in accordance to the MARES Statement of Work (MAR-546-ESA/JC, is. 1.4, Sept. 2001). Table 4-1 does not reflect the complete list of projects' deliverables, but only those deliveries related to the interfaces described in this document.

Some of the elements supplied by HRF will be needed at NTE during the MARES integration / verification phases and are identified in the "need date @ NTE" column by the corresponding need date. Other HRF provided elements (mostly flight items) are also identified as "not needed @ NTE".

Table 4-1: MARES Components suppliers

MARES ELEMENTS	NTE	HRF	RELATED INTERFACE	NEED DATE @ NTE	REMARKS
Main Box (TM, QM, FM, FMS)	X		MARES-VIF-M MARES-HRF-M MARES-LSA-M MARES-ExD-E MARES-PIP-E MARES-WS-SW		
Vibration Isolation Frame (FM, FMS)	X		MARES-VIF-M VIF-HRF-M		
Human Restraint System (TM, QM, FM, FMS)	X		MARES-PC-M MARES-PC-E MARES-PC-SW		
HRF MARES Rack Launch Structure Assembly (LSA)		X	VIF-HRF-M MARES-LSA-M	Feb '04	SDG46117502 Rev C One LSA plate item to be delivered to NTE for LSA-MARES vibration tests
Portable Computer (in-flight)		X	MARES-PC-M MARES-PC-E MARES-PC-SW	Not needed @ NTE	
Portable Computer (TM, QM, FM/FMS)	X		MARES-PC-M MARES-PC-E MARES-PC-SW		Part of the MARES TM,QM,FM/FMS respective GSE
SCSI Hard Disk x 2 (TM, QM, FM, FMS) (8 units in total)		X	MARES-HD-M MARES-HD-SW MARES-WS-SW	Feb. '04	Item related P/N: SEG46117767 (mechanical i/f) SEG46117769 (electrical i/f)

MARES ELEMENTS	NTE	HRF	RELATED INTERFACE	NEED DATE @ NTE	REMARKS
Fasteners (QM)	X		MARES-LSA-M		For qualification test purposes
Fasteners (FM, FMS)		X	MARES-LSA-M	Feb. '04	
MARES PCPW connector (TM/QM/FM/FMS)		X	MARES-PC-E	Oct. '03	MS3472L14-12S
Multibracket Assembly (FM/FMS)		X	MARES-PC-M	Not needed @ NTE	Item P/N: SEG33107631-301
Desk Top Plate Assembly (FM/FMS)		X	MARES-PC-M	Not needed @ NTE	Item P/N: SED33108703-302
Multibracket Assembly equivalent (TM, QM)	X		MARES-PC-M		
Desk Top Plate Assembly equivalent (TM, QM)	X		MARES-PC-M		
DC/DC Converter (flight) (*)		X	MARES-PC-E	Not needed @ NTE	Flight item P/N: SED39126010
PC Power Cables (flight) (*)		X	MARES-PC-E	Not needed @ NTE	Flight items P/N: SEG39129263, SEG39129264
120 VDC Power Cable (flight) (*)		X	MARES-PIP-E	Not needed @ NTE	Flight item P/N: SEG46115684
PC Ethernet Cable (flight) (*)		X	MARES-PC-SW	Not needed @ NTE	Flight item P/N: SEG46115687
PC Ethernet Card/Cable (flight) (*)		X	MARES-PC-SW	Not needed @ NTE	Flight item P/N: SEG46116862
WS2 Ethernet Cable (flight) (*)		X	MARES-WS-SW	Not needed @ NTE	Flight item P/N: SEG46115687
NFS (flight) (*)		X	MARES-PC-SW MARES-WS-SW	Not needed @ NTE	Interdrive Client v7.0

OTHER MARES RELATED ELEMENTS	NTE	HRF	RELATED INTERFACE	NEED DATE @ NTE	REMARKS
Power Interface Panel		X	MARES-PIP-E	Not needed @ NTE	
HRF Workstation 2 (flight)		X	MARES-WS-SW	Not needed @ NTE	

(*) For these elements, equivalent items will be provided in MARES TM, QM and FM/FMS respective EGSE